described by the specification to enable one of ordinary skill to make and/or use the invention. Applicant respectfully traverses these rejections.

The Office Action asserts that "item health metrics" and "tool health metrics" are not adequately defined by the specification. Specifically, the particular data obtained, timing of the data collection, and specific tools for collecting the data are not described. Applicant asserts that these details are matters of design choice governed by the particular implementation. Applicant provides particular examples of device parameters and tool parameters that may be measured to generate indications of item health (see page 12, lines 5-14) and tool health (see page 13, lines 3-13). Those of ordinary skill in the art are fully able to identify a particular tool to measure a particular characteristic. For example, one of the exemplary device parameters provided for determining item health is a transistor gate dimension. Those of ordinary skill in the art will surely know that multiple tools are available for determining this dimension, such as a scanning electron microscope. Applicant asserts that it is not necessary to specify each metrology tool for each possible characteristic to teach one of ordinary skill the invention.

The Office Action also asserts that Applicant does not provide sufficient timing information. Again, specific timing is a matter of design choice, however Applicant does provide exemplary timing points for determining item health characteristics (see page 11, lines 14-28):

> *Preprocess and post-process metrology information collected as a particular lot passes through the manufacturing system 10 may be used by the lot health monitor 130 to dynamically update the estimated lot health metric. At various steps in the process flow, the post-process metrology information may be correlated to an estimated lot health metric based on an empirical lot health model 135. The particular points in the process flow where the lot health metric is updated depend on the particular implementation. Exemplary lot health adjustment points include after the gate electrode has been formed (i.e., based on gate electrode physical dimensions), after formation of the first metal layer (i.e., based on drive current or effective channel length), after formation of the inter-*

level dielectric layer (i.e., based on measured dielectric constant), after formation of active source/drain regions (i.e., based on dimensions), after implant and thermal annealing (i.e., based on measured bulk resistivity, transistor threshold voltage, drive current, implant does and energy, implant anneal time and temperature), etc. The lot health model 135 may actually include a plurality of individual models for estimating lot health metrics based on information collected at the various estimation points.

These examples provide both timing and specific characteristics to be measured. As indicated above those of ordinary skill in the art are fully capable of determining a specific tool capable of measuring the characteristics and determining an estimate of item health based on the measurements. The relationships between item characteristics and their effects on item health are well known. For example, it in known that transistor dimensions have a quantifiable effect on speed or grade, and that particle contamination count has a direct impact on yield. Particular techniques for correlating measurements to estimate grade and yield are well known in the art.

The Office Action indicates that the term "grade" is not defined. "Grade" is defined by Webster as "a position in a scale of ranks or qualities." Applicant asserts that the term "grade" has a clear common meaning as well as a well-known meaning in the art. For example, microprocessors are typically graded based on maximum clock speed. Those of ordinary skill in the art are knowledgeable concerning the meaning of "grade" for a particular item being manufactured. The exemplary events described that have a potential impact on grade are provided to illustrate when grade or yield changes may occur. Again those of ordinary skill in the art are knowledgeable concerning what variable affect grade, when they might change, and how the changes impact the metric.

Regarding tool health, Applicant provides a reference to a commercial software product specifically adapted to determine tool health based on a monitoring of the process tool during its operation. Specifically, the ModelWare™ software calculates an index of tool health. Hence,

those of ordinary skill in the art are capable of using such software to determine the tool health metrics described and to adapt the software to different tools. Thus, no additional implementation specific details are required to enable the invention. As the Office action was easily able to give examples of multivariate modeling techniques, so would one of ordinary skill in the art. This assertion is supported by the availability of commercially available software for calculating the tool health metric described by Applicant. The reference to U.S. Patent Application 09/863,822 was amended to clarify that the subject application describes techniques for using different models in different processing situations.

The Office Action also asserts that a detailed description of the logical processes for converting data into scheduling procedures, including translation of metric units into scheduling times and units. The invention does not relate to the specific scheduling of time slots for particular tools. Rather the "scheduling" implicated by the claims refers to qualitatively directing items to various tools based on the interrelationship between the item health metric and the tool health metric. For example, items with high health metrics may be directed to tools with similarly high tool health metrics to preserve the health of the lot. This concept is clearly understandable based on the qualitative description. The scheduling described does not generate a particular time slot based on the metrics, but rather provides a qualitative input for scheduling decisions. For example, if two lots require the same processing and multiple tools are available for performing the processing, rather than assigning the lots randomly to the available tools, the lots can be differentiated by the qualitative item health metrics and tool health metrics for the available tools to determine which tool to select. Applicant provides specific examples, such as when a particular lot has a health metric below a predetermined threshold, the scheduling proceeds based on typical scheduling inputs (*e.g.*, lot priority, age, and tool availability).

Scheduling of this nature is well known to those of ordinary skill in the art. When a potentially valuable lot is identified, *i.e.*, as indicated by a high lot metric, the tool health metrics may be retrieved by the MES server and the identified lot may be routed to the best performing tool. The item and tool metrics are employed to qualitatively affect scheduling decisions, and those of ordinary skill in the art are capable of realizing such relationships and affects, given the thresholding example provided. A detailed mathematical relationship between a health metric and a particular scheduling time unit or slot is not necessary for understanding of the invention.

Claims 1-41 stand rejected under 35 U.S.C. § 112, 2nd paragraph as being incomplete for omitting essential elements and structural cooperative elements. The Office Action rejects the claims because the term "health metrics" is not defined. The terminology is defined by the specification and need not be defined in the claim. The Office Action also rejects the claims because no "means" are recited for obtaining this parameter, where in the processing line the determination is made, and how frequently the determination is made. First, claims 1-20 are method claims and are not required to provide "means" for performing the method. Claims 21-39 are system claims that provide structural elements for performing the functions attributed. The means provided are an item health monitor and a tool health monitor. These monitors are described by the specification as being implemented by software executing on a workstation. Claim 41 is a means function claim in accordance with 35 U.S.C. § 112, paragraph 6, which does not require the recitation of a particular structure. Regarding the place in the processing line and the frequency of determination, the specification provides examples of many places in the processing line where updates may occur and times at which they may occur. There is no requirement that the claim be limited to any particular location or frequency, so it not required to include such specific limitations in the claims.

Regarding the scheduling language, the claim recites scheduling the items based on the item health metrics and the tool health metrics. This provides the necessary connection between the claim elements. The particular implementation of a model for incorporating these metrics into scheduling decisions is not required to be explicitly defined in the claim. Applicant is entitled to broadly claim scheduling based on these metrics. A claim is not indefinite merely because it broadly claims scheduling based on particular factors when the prior art does not show incorporation of such factors.

> *It is axiomatic that during the prosecution of a patent application, claims are to be given their broadest reasonable interpretation. See In re Zletz, 893 F.2d 319, 13 USPQ2d 1320 (Fed. Cir. 1989). We agree with Beckestrom that Buell's claims do not require the laterally directed tension to be applied such that the gutters remain open during use. However, this fact by itself is not offensive to the second paragraph of 35 USC 112. While the claim language under consideration may be broad, breadth is not indefiniteness. See In re Gardner, 427 F.2d 786, 166 USPQ 138 (CCPA 1970). Instead, the second paragraph of section 112 simply requires the claims to set forth and circumscribe a particular area with a reasonable degree of precision and particularity. 22 U.S.P.Q. 2d 1128, 1133.*

Moreover, the dependent claims enumerate particular scheduling relationships. By definition, the parent claim is broader than the particular features enumerated by the dependent claims. There is no requirement to enumerate particular parameters, how they are measured, where they are measured, and how often they are measured for a claim to be definite. These items are a matter of implementation specific design choice, which one of ordinary skill in the art may readily understand. Applicant is not limited to claiming one particular implementation.

Claims 1 and 41 are adequately supported and definite for the reasons provided above. Applicant respectfully requests the rejection of claims 1-41 under 35 U.S.C. § 112 be withdrawn.

Claims 1-41 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,456,894 (Nulman). Independent claims 1, 21, and 41 include the general feature of scheduling items based on determined item health metrics in view of determined tool health metrics. The Office Action asserts that Nulman teaches these features. To the contrary Nulman does not teach scheduling based on a comparison between item quality and tool quality. Nulman looks at SPC information to identify tool problems (*i.e.*, stop production) or to set control limits for the devices. Nulman does not schedule based on tool and item quality (*i.e.*, selecting which tools to use). Nulman schedules based on tool availability, not based on a measure of quality for the items being processed and a measure of quality for the tools. Nulman looks at items such as power load management and spare parts requirements for scheduling. Nulman also uses SPC information related to item quality for process control, not as an input for the scheduling process. Accordingly, Nulman does not teach or suggest "scheduling the manufactured items for processing in the tools based on the item health metrics in view of the tool health metrics." Claims 1, 21, 41, and all claims depending therefrom are thus allowable. Applicant respectfully requests the rejection of these claims be withdrawn.

The dependent claims also include other features, such as particular scheduling operations based on the comparison between item and tool health that are not taught or suggested by Nulman (*e.g.*, claims 17-20, 37-40). The Office Action does not address these features with specificity. Applicant asserts that these claims are themselves allowable over Nulman. Applicant respectfully requests the rejection of these claims be withdrawn or that specific passages be cited in Nulman that teach or suggest these additional features.

In view of the remarks set forth herein, the application is believed to be in condition for allowance and notice to that effect is solicited. Nonetheless, should any issues remain that might

be subject to resolution through a telephonic interview, the examiner is requested to contact the undersigned patent agent with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

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REVISIONS

The paragraph starting on page 12, line 12 was amended as follows:

Typically, the tool health model 155 used to predict the operating parameters of the tool 30-80, thereby measuring the health of the tool 30-80, is based on the particular tool 30-80 and the base operating recipe employed by the tool 30-80 for processing the wafers. Hence, each tool 30-80 may have a separate tool health model 155 for each of the base operating recipes run on the tool 30-80. An exemplary tool health monitor software application is ModelWare™ offered by Triant, Inc. of Nanaimo, British Columbia, Canada Vancouver, Canada. An exemplary system for monitoring tool health using multiple models for different processing situations is described in U.S. Patent Application No. 09/863,822, entitled "METHOD AND APPARATUS FOR MONITORING TOOL HEALTH," filed in the names of Elfido Coss Jr., Richard J. Markle, and Patrick M. Cowan, that is assigned to the assignee of the present application and incorporated herein by reference in its entirety.

1. (Amended) A method for scheduling production flow, comprising:

processing a plurality of manufactured items in a process flow;

determining item health metrics for at least a subset of the plurality of manufactured items;

determining tool health metrics for a plurality of tools in the process flow; and

scheduling the manufactured items for processing in the tools based on the item health metrics [and] in view of the tool health metrics.

21. (Amended) A manufacturing system, comprising:

a plurality of tools for processing a plurality of manufactured items in a process flow;

an item health monitor configured to determine item health metrics for at least a subset of the plurality of manufactured items;

a tool health monitor configured to determine tool health metrics for at least a subset of the plurality of tools; and

a scheduling server configured to schedule the manufactured items for processing in the tools based on the item health metrics [and] <u>in view of</u> the tool health metrics.

41. (Amended) A manufacturing system, comprising:

means for processing a plurality of manufactured items in a process flow;

means for determining item health metrics for at least a subset of the plurality of manufactured items;

means for determining tool health metrics for a plurality of tools in the process flow; and

means for scheduling the manufactured items for processing in the tools based on the item health metrics [and] <u>in view of</u> the tool health metrics.